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ANALYSTS OF DIFFERENCES BETWEEN POLLUTION CONTROL COST ESTIMATES

Prepared for: Environmental Protection Agency

by

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DISCLAIMER

I. BEET SUGAR

Introduction:

The cost for the beet sugar industry to meet BPT guidelines in 1977 is projected by NBER and SEAS. Three categories of cost estimates were compared: the investment cost for existing plants, the investment cost for new plants, and the operating and maintenance costs associated with these investments. Both NBER and SEAS derive their estimated costs from the EPA "Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards" for the Beet Sugar segment of the sugar processing industry published in January, 1974.

Categorization:

The category beet sugar corresponds for both estimates to SIC 2063. This industry contains 55 beet sugar plants. The projected costs for these plants to meet BPT guidelines are shown in Table I-A.

Investment Cost:

The NBER estimate of 9.6 million is based on their belief that only 5 plants will need to implement additional treatment to meet BPT. Thus although both assume only 10 per cent of the industry require BPT investment (in other words their KIP assumptions are the same) their cost is distributed differently. SEAS however, spreads the cost over the entire 55 plant industry. Table I-B shows the distribution of the model plants into capacity ranges and the associated costs per plant. There are two important points to notice about this table; the investment per plant for SEAS is significantly lower for comparably sized plants and the model plant distribution for SEAS is skewed in the direction of the larger model plant. Consequently, SEAS estimates are influenced by the economics of scale that occur with the larger plant size.

The difference in cost per plant is additionally explained by land cost assumptions. SEAS uses EPA Development Document estimates of $1,000/acre while NDER increases this to $2,500/acre. NBER rationalizes this increase by stating that its 5 plants are located in the Midwest where land costs are closer to $2,500 than $1,000. Land costs are 30-40% of the total investment cost.

Fox example, in the NBER study, a plant producing 2,000 tons/day has land requirements of 244 acres. The associated lands costs, assuming $1,000/acre equals $244,000 while at $2,500/acre the cost is $610,000, or a cost differential of 2.5.

Expansion:

NBER projects growth for the period 1974-77 will require an investment of $1.9 million while SEAS projects $.4 million. NBER bases its projection on the assumption that three plants, with a combined capacity of 10,000 tons/day, will start up before 1977. Taking this capacity and putting it into the SEAS investment equation, ($Y=ax^b$), and using cost parameters a and b based on NSPS projections, yields an investment total of $13.5 million. Following the NBER assumption that 90% of this total would be spent even in the absence of NSPS, this figure is adjusted to 1.35 million. The figure of 1.35 million compares favorably to the NBER derived total of 1.9 million.

In other words; using NBER data and the SEAS investment equation to generate one figure; and using the NBER 10% growth assumption for the other figure, yields totals of 1.35 million and 1.9 million.

Operation and Maintenance:

The difference in O&M numbers--$.72 million for NBER versus $10.9 million for SEAS is due to two factors. The first is a different interpretation of the development documents. This document states O&M is 10% of capital investment. Should land costs be considered part of capital investment? SEAS assumes it should while NBER assumes it shouldn't. The second factor is the difference in accounting procedure in O&M measurement. NBER calculates incremental costs for the five plants requiring BPT investment, while SEAS bases its calculations on industry-wide BPT investment.

Using a calculation similar to the one that compared expansion costs, i.e. fitting NBER data into the SEAS investment equation, yields figures of $.125 million O&M cost for NBER, versus $.15 million for SEAS for new plants.

Summary:

- Investment totals differ because

  1. different distribution of investment costs
  2. different model plant sizes and costs
  3. different assumption of land costs

- Expansion totals differ because

  1. different growth rates are assumed

- O&M totals differ because

  1. different definitions of capital investment
  2. different accounting procedure

Table I-A

Beet Sugar Industry Costs
(Millions of 1975 Dollars)

NBER 1972-77			SEAS 1974-77		
Investment	Expansion	O&M	Investment	Expansion	O&M
9.6	1.9	.72	3.6	.4	10.9

Table I-B

Model Plant Data

NBER			SEAS		
Plant Size (tons/day)	Number of Plants	Invest/ Plant	Plant Size (tons/day)	Number of Plants	Invest/ Plant
1400	1	892,350	2300-	16	395,035
1900	1	1,151,600	2300- 3900	17	521,686
2000	2	1,202,600	3900+	19	722,995
4000	1	2,239,600			

II. ZINC INDUSTRY

The estimate of abatement costs required by the primary zinc group of the metal industry to meet federal federal guidelines as reported in the 1974 "Cost of Clean Air" report submitted to Congress by EPA is compared with the esimtate proposed by SEAS. The C.C.A. report gives an investment figure of $38.9 MM, whereas SEAS predicts a cost of $54.2 MM, $14.868 MM for existing facilities, and $39.33 2 MM for new facilities and expansion within the industry. The CCA abatement cost figure is for the time period 1971-1979, and the SEAS figure is for the period 1972-1979.

Source Data:

The source data used by both EPA and SEAS to predict abatement costs was taken from estimates prepared by Battelle.

Results:

It was found that the reason for discrepancy between EPA and SEAS is due mainly to the following factors:

1. EPA computes only the incremental cost required to upgrade existing facilities to federal standards. SEAS computes an incremental abatement cost required by existing facilities, new facilities and growth within existing facilities to meet the standards.

2. EPA and SEAS compute abatement costs for different segments of the industry.

3. Of total abatement expenditures, EPA assumes 100% is due to BPT guidelines, whereas, SEAS assumes only 16%. 16%.

Model Plant Definition

Existing Sources

According to Battelle documents, the primary zinc industry consists of eight plants. Three of these plants, however, are scheduled to close--two by the end of 1973 and one by June, 1975. Table 1 gives a listing of the plants, including 1972 emission levels. Note that five of the eight plants currently operate within federal effluent guidelines--three do not. Two of the three plants which do not operate within guidelines are two of the plants scheduled to close. The other plant which does not meet federal guidelines is one of the five plants scheduled to remain open.

Battelle and EPA choose as model plants the three plants which do not operate within federal guidelines, even though two of the plants are scheduled to close. SEAS chooses as model plants the five plants which are scheduled to remain open, even though only one plant fails to operate within federal guidelines. The only model plant common to Battelle, EPA and SEAS is the 153,000 t/yr capacity plant that does not operate within federal guidelines and is scheduled to reamin open.

New Plants

Three new zinc plants are scheduled to be built. Statistics for these plants is given in Table 2. Both Battelle and SEAS develop costs for these plants; EPA does not.

Investment and O&M Costs

The $38.9 MM investment cost given by EPA reflects those costs to be incurred by the existing industry. Since EPA does not compute abatement costs for new capacity, only the fraction of the SEAS estimate associated with existing facilities is compared to EPA's cost estimate. A separate cost comparison is also made for the 153,000 t/yr capacity model plant which is common to both SEAS and EPA. The cost estimate that SEAS gives for new capacity is compared to cost information given in the Battelle report.

Investment and O&M Costs--Existing Capacity

Model plant data for EPA and SEAS is shown in Table 4. For the model plant of capacity 153,000 t/yr which both EPA and SEAS have in common, the following abatement costs are given:

	EPA	SEAS	% Difference
Capital, MM $	13.920	14.848	6.25
O&M, MM $	1.238	1.270	2.53

Total industry incremental costs (for existing capacity only) for EPA and SEAS are computed as follows:

A. EPA--EPA assumes no capital-in-place.

Capacity Feed t/yr	# Plants	Capital $MM	O&H $MM
153,000	1	13.920	1.238
100,000	1	10.404	0.923
164,000	1	14.640	1.315
TOTAL		38.964	3.476

B. SEAS--SEAS assumes 84% of capital for existing sources is already in place.

Capacity Feed t/yr	# Plants	Capital $MM	O&M $MM
153,000	1	2.376	1.270
215,000	1	2.938	1.642
364,000	1	4.079	2.447
192,000	2	5.475	3.016
TOTAL		14.868	8.375

Even though the capital costs for the model plants are comparable, but because of differing capital-in-place assumptions, EPA gives an investment cost that is 6 times higher than the SEAS cost for the 153,000 t/yr plant (O&M costs are nearly equal). In the period 1971-1974, this 153,000 t/yr SEAS plant consisted of 13.7% of the total (industry wide) plant capacity. The following chart shows the 13.71% capacity level in relation to total SEAS capacity:

SEAS:

Capacity	% Capacity Shares 1971-1974
364,000	32.62
215,000	19.27
153,000	13.710
192,000	34.400

13.7% is roughly equivalent to the 16% capital-not-in-place figure SEAS uses for all plants in the industry. Since SEAS costs are only for plants scheduled to remain open, comparing SEAS 16% figure cost spread over the entire industry with the cost for the 153,000 t/yr EPA plant gives $14.868 and $13.92 MM for SEAS and EPA, respectively.

Investment and O&M Costs--New Capacity

EPA does not compute costs for new capacity, therefore, no comparison can be made with SEAS. According to model plant data, however, Battelle and SEAS give estimates for new plants with capital costs differing by only 8-9%, but with O&M costs for Battelle 63-64% higher than estimates made by SEAS:

	Battelle	SEAS	% Difference
91,000 t/yr			
Capital, $/ton	108.46	118.01	8.09
O&M, $/ton	26.07	9.42	63.87
290,000 t/yr			
Capital, $/ton	69.17	76.30	9.34
O&M, $/ton	19.47	7.11	63.48
327,000 t/yr			
Capital, $/ton	66.15	72.92	9.28
O&M, $/ton	18.81	6.90	63.32

If operated at full capacity, the three new plants would give the total capital costs of $51.56 MM and $56.711 MM for Battelle and SEAS, **respec-tively**. The SEAS model, however, predicts only a 5.62% annual growth rate through 1979 (as opposed to 12.69% at full capacity) with a capital cost of only $39.332 MM.

Capacity. Feed t/yr	Percentage of Total U.S. Capacity (expected)	
	Battelle	SEAS
327,000	29	17.92
290,000	26	15.90
91,000	8	4.99

TABLE 1. PRIMARY ZINC STATISTICS
(Battelle Statistics)

State	Capacity Tons Feed Per Year	Operation	Present Control Device	Particulate lb/day (at capacity)	SO_2 ton/day (at capacity)	Federal Standard SO_2
Texas** Amarillo	96,000	Ropp Roaster		1,315	9	14
		Sintering Machine	Baghouse	400	--	
		Reduction (Horiz)	None	26,000	--	
Pennsylvania Monaca	364,000	Flash Fluid-Bed & Multi-hearth Roasters	Acid Plant with associated gas cleaning equipment*	4,000	33	45
		Sintering Machine	ESP and Baghouse			
Pennsylvania Palmerton	215,000	Flash Roaster	Acid Plant with associated gas cleaning equipment *	600	19	29
		Sinter & Briquet	Venturi scrubber	4,400	--	
Oklahoma*** Blackwell	164,000	Green Ore Sintering	Baghouse	900	297	23
		Reduction (Horiz)	None	45,000		
Illinois (Amax) Sauget	153,000	Fluo Solid	Acid plant with associated gas cleaning equipment*	800	277	21
Oklahoma*** Bartlesville	100,000	Fluidized-bed roaster	Acid plant with associated gas cleaning equipment*	92,000	181	15
		Sintering machine	Baghouse	410	--	
		Reduction (Horiz)	None	27,400		
Idaho Wallace	186,000	Roaster (Flash)	Acid plant with associated gas cleaning equipment*	3,000	17	25
Texas Corpus Christi	196,000	Roaster (Flash)	Acid plant with associated gas cleaning equipment*	3,000	18	26
Totals	1,474,000			216,700	850	198

* Gases from the roaster pass through a dust collection system (ESP, cyclones, and flues); final cooling commonly done in a scrubbing tower. The cleared SO_2 gas is converted to SO_3 by catalytic action and adsorbed in water to form H_2SO_4. The residual gases pas through a final mist eliminator before being vented to the stack.

** Scheduled to close by 1975.

TABLE 2

NEW PLANTS OF ZINC INDUSTRY

Capacity, Feed tons/yr (kkg/yr)	Type of Operation
327,000 (296,000)	electrolytic
290,000 (264,000)	electrolytic
91,000 (82,000)	electrolytic

TABLE 3

BATTELLE MODEL PLANT DATA (FY71-FY80)

Capacity, Feed tons/yr	Capital Investment $	O&M $	Abatement Costs, $/ton Feed Capital	O&M
Existing Facilities				
153,000	13,984,000	1,243,000	91.40	8.12
100,000*	10,409,000	908,000	104.09	9.08
164,000*	14,388,000	2,626,000	87.73	16.01
New Facilities				
91,000	9,870,000	2,372,000	108.46	26.07
290,000	20,059,000	5,647,000	69.17	19.47
327,000	21,632,000	6,151,000	66.15	18.81

*Scheduled to close

TABLE 4

EPA-SEAS MODEL PLANT DATA

EPA					SEAS				
Capacity, Feed tons/yr	Capital $MM	O&M $MM	Abatement Costs, Capital	$/ton Feed O&M	Capacity, Feed tons/yr	Capital $MM	O&M $MM	Abatement Costs, Capital	$/ton Feed O&M
Existing Facilities									
153,000	13.920	1.238	90.98	8.09	153,000	14.848	1.270	97.05	8.30
100,000**	10.404	0.923	104.04	9.23	215,000	18.360	1.642	85.40	7.64
164,000**	14.640	1.315	89.27	8.02	364,000	25.495	2.447	70.04	6.72
					192,000 (2 plants)	17.108	1.508	89.10	7.85
New Facilities									
					91,000	10.739	.857	118.01	9.42
					290,000	22.126	2.061	76.30	7.11
	none				327,000	23.846	2.257	72.92	6.90

**scheduled to close

III. COPPER INDUSTRY

Introduction:

The estimates of abatement costs required by the primary smelting copper group of the metals industry as proposed by EPA (Cost of Clean Air) and SEAS are compared. The C.C.A. report predicts an incremental capital investment of $589.2 MM; SEAS predicts an investment of $1177.4 MM.*

Source Information:

EPA and SEAS reports are based on information furnished by Battelle.

Results:

The major reasons for discrepancies include:

1) EPA reports only costs associated with upgrading existing facilities to SIP, no estimate is made for within-industry growth or new facilities being built, SEAS costs include SIP investment for existing, expanded and new capacity

2) EPA and SEAS develop costs for different portions of the industry.

Model Plant Data:

According to Battelle reports the primary copper smelting industry consisted of 15 plants in 1973. The source of pollution in these plants were the roaster, reverberatory and converter furnaces. Battelle separates the industry into the following categories:

a) plants with emissions from roaster, reverberatory and converter furnaces -- seven
b) plants with emissions from reverberatory and converter furnaces -- eight. Of these eight, two are undergoing construction; one is three-fourths complete, and the other is under

*EPA costs are for time period FY71-FY80; SEAS costs are for time period, 1972-1979.

early stages of construction in New Mexico.

Capacity and model plant data are given in Tables 0 and 1, respectively.

EPA Model Plants:

Of the total 15 plants, EPA develops costs for only 13. The New Mexico plant, which is under construction, and the Michigan plant, which has negligible emissions, are not costed. EPA divides the 13 plants into model plants according to size capacity. Model plant data for EPA is given in Table 2.

SEAS Model Plants:

Of the 15 plants, SEAS develops abatement costs for the entire group. However, unlike EPA, SEAS divides the plants into three model groups according to abatement technology -- with roaster, without roaster, and new plant (without roaster). Model plant data for SEAS is given in Table 3.

Investment and O&M Costs:

The investment cost given by EPA (CCA) is the incremental investment required by the existing industry. SEAS' estimates however, is the incremental cost for existing growth within existing plants, and the new plant being built. A comparison is made only of the abatement costs associated with existing capacity levels since this is the only common category. From Table 4, the following figures are computed:

	EPA	SEAS	% Difference
Investment, MM $	590.00	664.23	11.8
O&M, MM $	74.00	82.32	10.11

However, if the costs associated with the Michigan plant, which has negligible emissions, is subtracted from the SEAS estimate, the following costs are obtained:

	EPA	SEAS	% Difference
Investment MM $	590.00	630.87	6.48
O&M, MM $	74.00	78.08	5.23

Expanded and New Capacity:

EPA does not compute costs associated with extended or new capacity, therefore no comparison can be made with SEAS. However, EPA does anticipate an annual copper production growth of 2% and while SEAS assumes an annual growth rate greater than 8.5%, SEAS' costs of $540.47MM will be incurred with $27.3 MM for the new plant and $513.17 MM for expansion within the industry. In the following table the SEAS cost for the new plant is compared with information given by Battelle

	BATTELLE	SEAS	% Difference
Investment MM $	24.1	27.3	11.72
O&M, MM $	8.8	4.1	53.41

Battelle apparently assumes that $5.5 M of the O&M costs and $19.2 MM of the investment costs are due to NSPS. SEAS assumes entire O&M and investment costs are due to SIP.

Table 1

Model Plant Data - Battelle*

A. Roaster Reverberatory, Converter Furnace

Number plants = 7
Total Capacity = 4,931,000 tons feed/yr
Average Capacity = 704,400 tons feed/yr

Model Plant Number	Capital MM $	O&M MM $
1	25.6	2.7
2	37.1	4.4
3	73.6	9.3
4	50.9	7.6
5	47.2	5.4
6	64.2	6.9
7	70.0	8.7

B. Reverberatory; Converter Furnace

Number plants = 7
Total Capacity = 3,510,000 tons feed/yr
Average Capacity = 501,400 tons feed/yr

Model Plant Number	Capital MM $	O&M MM $
8	36.2	6.5
9	24.6	5.3
10	4.9	3.3
11	40.7	4.0
12	26.2	4.5
13	43.8	4.9
14	48.2	6.6
15	26.3	6.2

C. New Plants (Capacity)

Model Plant Number	Capital MM $	O&M MM $
10 (Converter)	19.2	5.5
11 (Reverberatory)	5.6	5.6

*Some error may be due to rounding. Costs are for period FY71-FY80.

Table 2

Model Plant Data - EPA

Capacity Feed tons/yr	# Plants	Capacity Range tons/yr	Capital MM $	O&M MM $
250,000	4	425,000	27.36	3.24
600,000	7	425,000-999,000	50.40	6.36
1,000,000	2	1,000,000	66.36	9.84

Table 3

Model Plant Data - SEAS

	Capacity Feed tons/yr	# Plants	Capital MM $	O&M MM $
Existing w/roaster	704,000	7	61.53	7.52
w/o roaster	501 ,429	7	33.36	4.24
New	400,000	1	27.30	4.10

(Battelle Statistics)

TABLE C PRIMARY COPPER INDUSTRY DATA

State	Capacity Tons Feed per Year	Operation	1970 Control Device	1970 Particulate lb/Day (at Capacity)	1970 SO_2 Ton/Day (at Capacity)
Arizona	250,000	Roaster	ESP	200	7
		Reverb	ESP	3,200	95
		Converter	ESP	3,200	308
		Refining	None	--	--
Arizona	420,000	Reverb	ESP	2,700	160
		Converter	Multi Cyclone	8,000	518
Arizona	450,000	Reverb	None	5,700	171
		Converter	None	5,700	555
Arizona	670,000	Roaster	ESP	8,600	376
		Reverb	ESP	1,700	255
		Converter	ESP	8,600	826
		Refining	None	--	--
Arizona	875,000	Roaster	ESP	12,200	491
		Reverb	None	111,700	333
		Converter	ESP	12,200	1,079
Arizona	900,000	Reverb	ESP	11,500	343
		Converter	ESP	11,500	1,110
		Refining	--	--	--
Arizona	960,000	Roaster	ESP	2,500	539
		Reverb	ESP	2,500	366
		Converter	ESP	12,300	1,184
Michigan	250,000 [a]	Reverb	ESP & Balloon Flue	[b]	Negligible
		Converter	--	--	--
		Refining	--	--	--
Montana	1,000,000	Roaster	None	127,600	562
		Reverb	None	127,600	380
		Converter	None	127,600	1,233

Footnotes appear on the following page.

TABLE C (Continued)

State	Capacity Tons Feed per Year	Operation	1970 Control Device	1970 Particulate lb/Day (at Capacity)	1970 SO_2 Ton/Day (at Capacity)
Nevada	400,000	Reverb	ESP	5,100	152
		Converter	ESP	5,100	493
		Refining	ESP	--	--
New Mexico	400,000	Reverb	ESP	2,600	152
		Converter	None	51,000	493
Tennessee	90,000	Reverb	ESP	1,500	34
		Converter	Cyclone	2,900	111
Texas	576,000	Roaster	ESP	7,400	324
		Reverb	ESP	7,400	219
		Converter	ESP Acid Plant	400	36
Utah	1,000,000	Reverb	ESP	70,200	381
		Converter	ESP Acid Plant	600	62
Washington	600,000	Roaster	ESP	400	17
		Reverb	ESP	7,700	228
		Converter	ESP	400	37

(a) Estimated.

(b) Particulates are reportedly within ambient air quality standards.

IV. PULP AND PAPER - Phase I

Introduction:

The cost for the pulp and paper industry to meet BPT guidelines is projected by NBER and SEAS. These projections are broken out into Phase I and Phase II estimates. The terms Phase I and Phase II refer to industry groupings originally made by the EPA development document and in no way correspond to BPT and BAT. The Phase I grouping consists of the unbleached kraft (UK), neutral sodium sulfite semi-chemical (NSSC), combined UK/NSSC, and paperboard from wastepaper industries. The Phase II grouping includes the groundwood, bleached kraft, soda, sulfite, deinking, and non-integrated segments of the industry.

Three categories of cost estimates were compared for Phase I, the investment cost for existing plants, the investment cost for new plants, and the operating and maintenance costs associated with these investments. Both NBER and SEAS derive their estimated costs from the EPA "Development Document for the Unbleached Kraft and Semichemical Pulp" industries (January 1974), and the August 1975 development document for the "Bleached Kraft, Groundwood, Sulfite, Soda, Dcink, and Non-Integrated Paper Mills."

Categorization:

For the category "Pulp and Paper" NBER aggregates SICs 2611 (Pulp Mills), 2621 (Paper Mills, except Building Paper Mills), and 2631 (Paperboard Mills); SEAS confines itself to SIC 2621. However, since many pulp mills are closely linked physically with paper mills there is a greater overlap of categories than the SIC correspondance indicates. Consequently, SEAS includes plants in their analysis that NBER places in SICs 2611 or 2631.

Investment Cost:

Table II-A shows BPT investment figures. Since this is a large industry comprising many different plant types, the following analysis is broken out into Phase I and Phase II investments,

For the four industry groupings that comprise Phase I, the number of plants, capacities, model plant sizes, investment per grouping and KIP assumption are examined. Tables II-B and II-C lists these comparisons. The plant totals for each subcategory are approximately equal in two of the four industries. The small discrepancies among the other two sectors are easily explained; for example, NBER discounts four NSSC plants because they have negligible BPT costs. SEAS, however, includes these plants in their 15 plant subcategory. In the paper board category, NBER takes out half of the 165 plants by assuming these have secondary treatment in place and consequently require no additional BPT investment. SEAS does not make this assumption.

For plant capacities both SEAS and NBER slightly modify the development document estimates. The NBER changes are a consequence of the assumption that plants discharging to waterways are the same size on average and those discharging to municipalities. The rational for the SEAS changes has not been determined. Capital in place assumptions are the same with the minor exception of .5 for the NSSC sector estimated by NBER and .54 for SEAS. None of these differences however, account for the two fold difference in investment totals generated by the two estimates.

Model plant size and the corresponding cost per plant for meeting BPT largely explains the different estimates. NBER takes its data directly from the development document. Thus, for the unbleached kraft sector (UK) they base their calculation on a model plant size of 1000 tons per day, with a cost of 14.4 million dollars per plant. On the other hand, SEAS uses three model plant sizes of 355, 762, and 1252 tons per day and uses different cost curves associated with these plants. The specific breakdown of cost esimates for these plants is as follows: 3 plants for $4 million per plant, 11 plants for $5.6 million per plant, 3 plants for $2.5 million per plant, and 6 plants for $4.1 million per plant. The weighted average cost for these model plants is $6.4 million per plant. Then there is an $8 million difference per plant in the unbleached kraft sector.

O&M Investment

NBER estimates a cost of $41.7 million while SEAS projects a cost of $121.5 million. The principle reason for this three fold difference stems from the different philosophies of two reports use in distributing industry-wide costs. As stated before, NBER bases its projections only on those plants requiring additional BPT investment. This assumption nets out 83 plants (or approximately 40% of the total number of plants) that SEAS counts. Consequently, NBER projects O&M expenses for only 130 plants while SEAS projects these expenses for 213 plants. As a result, SEAS O&M projections are larger.

Summary

- Investment totals differ because
  1. different model plant costs
  2. different distribution of investment costs over industry
- Expansion totals differ because
  1. different model plant costs
  2. these growth rates are applied against a different capacity base
- O&M totals differ because
  1. a different number of plants are counted for this expense

Table II-A

Pulp and Paper Industry Costs
(Millions of 1975 Dollars)

	NBER 1972-77			SEAS 1974-77		
	Invest.	Expan.	O&M	Invest.	Expan.	O&M
Phase I	328.8	40.9	41.7	182.7	16.6	121.5
Phase II	1523.5	152.4	117.1	847.2	126.6	279.8
Total	1851.8	193.3	189.8	1029.8	143.2	401.3

Table II-B

Input Comparison

	# plants	Capacity (tons/day)	Model plant size	KIP %	# plants	Capacity (tons/day)	Model plant size	KIP %
	27	25,000	1000	.4	23	21,697	355,762,1252	.4
SC	10	10,421	1000	.4	10	13,965	752,1271,1833	.4
	11	4,392	250	.5	15	3,632	150,279,550	.54
OARD	82	10,500	100	.61	165	28,555	77,190,658	.61

Table II-C

Model Plant Costs

(Millions of 1975 Dollars)

Sector	NBER Cost/Plant	SEAS # of Plants	SEAS Cost/ Plants	SEAS Average Cost/ Plant
UK	14.4	3	4.0	6.4
		11	5-6	
		3	2.5	
		6	4.1	
UK/NSSC	12.6	2	4.2	4.8
		2	9.5	
		1	4.2	
		2	5.9	
		3	7.4	
NSSC	4.9	6	.6	1.2
		1	1.1	
		1	.8	
		4	1.3	
		4	1.8	
Paperboard	1.4	45	.6	1.0
		29	1.2	
		8	2.5	
		46	1.1	
		29	5.1	
		8	.9	

Table II-D

BPT Investment Comparison

(Millions of 1975 Dollars)

	NBER	SEAS	NBER/SEAS
UK	358.4	148.6	173.3
UK/NSSC	129.7	47.5	37.6
NSSC	85.8	169.1	13.9
Paperboard	144.5	169.1	150.8

Above totals multiplied by KIP figure and added yield:

	326.1	192.4	184.5

A similar analysis for the other three sectors reveals a similar differential in model plant sizes and costs with the exception of the paperboard industry. For paperboard both NBER and SEAS use plant costs that are relatively close - $1.4 million versus $1.0 million - the sector totals of $144.5 million versus $169. million are relatively close. The SEAS estimate is higher than NBER's estimate because SEAS counts 83 more plants in this sector.

Table II-D shows the comparitive results generated by taking NBER capacity figures (tons per day from Table II-B) and feeding them into the SEAS investment equation. Note the totals of $192.4 million for SEAS fits very well with the derived NBER figure of $184.5 million. These totals provide further support for the conclusion that model plant cost differences largely account for the different investment numbers estimated by NBER and SEAS.

Expansion:

The expansion investment totals for Phase I are $40.9 million for NBER and The studies use different growth rates which explains the variation between the two numbers, NBER assumes that the expected annual growth in output will be paralleled by growth in BPT. The specific growth rates used are: for UK 12%, for UK/NSSC 15%, for NSSC 15.4%, and for wastepaper 10.2%. These percentages are the growth the sectors will experience over the time period 1972-77. SEAS takes one growth rate .71% and applies it for all sectors annually. Their use of a smaller growth rate is partially compensated for by SEAS application of the growth rate to the Phase I category that includes more plants than NBER attributes to Phase I.

In other words, SEAS uses a smaller growth rate but applies it annually (as opposed to NBER's cumulative growth rate) to a larger industrial capacity than NBER user. The net effect is a total number about 1/7 smaller than NBER's total expansion investment number.

V. IRON & STEEL INDUSTRY - Existing Capacity

Abatement cost estimates given by NBER and SEAS for the iron and steel industry are compared. The industry is defined by SIC numbers 3312, 3315, 3316, 3317, 3321 and 3323 and is divided into subcategories as follows:

I. Phase I

a) By-product Coke Subcategory
b) Beehive Coke Subcategory
c) Sintering Subcategory
d) Blast Furnace - Iron Subcategory
e) Blast Furnace - Ferromanganese Subcategory
f) Basic Oxygen Furnace - Semiwet Air Pollution Control Methods Subcategory
g) Basic Oxygen Furnace - Wet Air Pollution Control Methods Subcategory
h) Open Hearth Furnace Subcategory
i) Electric Arc Furnace - Semiwet Air Pollution Control Methods Subcategory
j) Electric Arc Furnace - Wet Air Pollution Control Methods Subcategory
k) Vacuum Degassing Subcategory
l) Continuous Casting Subcategory

II, Phase II

a) Basic Oxygen Furnace - Wet Air Pollution Control Subcategory - Specialty Steel
b) Vacuum Degassing Subcategory - Specialty Steel
c) Continous Casting and Pressure Slab Molding Subcategory - Specialty Steel
d) Hot Forming Primary Subcategory
e) Hot Forming Section Subcategory
f) Hot Forming Flat Subcategory
g) Pipe and Tubes Subcategory

h) Pickling - Sulfuric Acid - Batch and Continuous Subcategory

i) Pickling - Hydrochloric Acid - Batch and Continuous Subcategory

j) Cold Rolling Subcategory

k) Hot Coat - Galvanizing Subcategory

l) Hot Coat - Terne Subcategory

m) Miscellaneous Runoffs Subcategory

n) Combination Acid Pickling (Batch and Continuous) Subcategory

o) Scale Removal (Kolene and Hydride) Subcategory

p) Wire Coating and Pickling Subcategory

q) Continuous Alkaline Cleaning Subcategory

r) Cold Coatings Subcategory (Costs incurred as a result of guidelines for electroplating)

The source documents used by NBER and SEAS in deriving cost estimates are:

i. Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category. (EPA - 440/1-74-024-a)

ii. Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Forming, Finishing and Specialty Steel Segments of the Iron and Steel Manufacturing Point Source Category. (EPA 440/1-76/048-b,Group I, Phase II)

Results:

NBER gives an abatement cost estimate of $1100 MM* for initial investment and $158 MM for O&M. SEAS given an estimate of $864.7 MM for initial investment and $1071.8 MM for O&M. It was found that the cost discrepancies between SEAS and NBER mainly occur for the following reasons:

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*NBER costs are for the time period 1972-1977; SEAS costs are for time period 1974-1977

1. The industry subcategories for which NBER and SEAS develop costs differ.

2. The costs computed by NBER are the incremental investment costs that the existing 1972 industry would incur in upgrading its treatment to BPT. The costs computed by SEAS also includes the incremental investment incurred by growth within the industry as well as the costs incurred by the existing industry.

3. In many cases, the level of abatement technology required to meet BPT guidelines is defined differently by NBER and SEAS. NBER costs for BPT treatment are comparable to SEAS costs for BPT and BAT treatment.

4. Within some of the individual subcategories, different types of abatement technology are defined by SEAS and NBER.

Analysis:

In order to achieve equalization of costs, subcategories common to both NBER and SEAS were identified for comparison. Of the 30 subcategories for the total industry, the following 14 subcategories are common to both SEAS and NBER:

I. Phase I
   a) By-product Coke
   b) Blast Furnace
   c) Basic Oxygen Furnace - Wet and Semiwet Air Pollution Control Methods
   d) Open Hearth Furnace
   e) Electric Arc Furnace - Wet Air Pollution Control Methods

II. Phase II
   a) Hot Forming - Primary
   b) Hot Forming - Section
   c) Hot Forming - Flat

d) Open Hearth furnace

e) Electric Arc Furnace - Wet Air Pollution Control Methods

II. Phase II

a) Hot Forming - Primary

b) Hot Forming - Section

c) Hot Forming - Flat

d) Pickling - Sulfuric Acid - Batch and Continuous

e) Pickling - Hyrdrochloric Acid - Batch and Continuous

f) Cold Rolling

g) Hot Coatings - Galvanizing

h) Cold Coatings

For these 14 subcategories, SEAS and NBER estimates of the incremental BPT investment are compared. Because the NBER estimate is the cost to the existing industry, the SEAS cost for the existing industry is extracted from the total SEAS estimate for comparison with NBER. Revised cost estimates are as follows:

	NBER	SEAS
# Plants	671	652
1972 Capacity, MM tons	467.6	653.4
Captial Cost, MM $	886.13	643.63
O&M, MM $	107.89	426.35

Table 1 gives the abatement costs for each of the 14 subcategories. The following 6 subcategories were found to have large differences in costs and consequently, were chosen for further analysis.

	SEAS			NBER		
Subcategory	# Plants	Capital MM $	O&M MM $	# Plants	Capital MM $	O&M MM $
Open Hearth Furnaces	6	1.61	2.24	5	16.75	0.52
Blast Furnaces	68	203.00	243.15	68	140.57	8.13
Hot Forming - Section	85	46.94	8.92	80	172.90	12.46
Pipes & Tubes	75	1.74	0.14	50	26.04	2.66
Cold Rolling	45	10.04	4.14	45	55.44	6.58
Hot Coatings	30	11.27	1.25	30	34.02	2.38
Total	309	274.60	259.84	278	445.72	32.73

Open Hearth Furnaces

Abatement costs for the subcategory are as follows:

	SEAS	NBER	% Difference
# plants	6	5	-----
Capital, MM$	1.61	16.75	90.39
O & M, MM$	2.24	0.52	76.79

The primary source of discrepancy between SEAS and NBER estimates is the inclusion in NBER's estimate of $13.02 MM for the "probable" installation of wet air pollution control devices. The cost to the five plants listed above is only $3.73 MM.

Two other sources of cost discrepancy are first SEAS develops costs based on two types of technology - plants with wet air pollution control devices, i.e. filters for solids dewatering (FSD), and plants without. NBER develops costs for plants with wet air pollution control devices; and second, the cost that NBER associates with BPT is more corn-parable to costs that SEAS attributes to BPT and BAT.

In Table 2, Model plant data for NBER and SEAS is given, BPT and BAT costs are given for SEAS; only BPT is given for NBER. From this model plant data, the following investment costs are calculated:

	SEAS	NBER	% Difference
Capital, MM$	1.61 (BPT)	3.73 (BPT)	56.84
O&M , MM$	2.24 (BPT)	0.52 (BPT)	76.79
Capital, MM$	4.66 (BPT + BAT)	3.73 (BPT)	19.96.
O&M, MM$	2.53 (BPT + BAT)	0.52 (BPT)	79.45

Note that when SEAS BPT + BAT costs (as opposed to only BPT costs), are compared with NBER, BPT costs the difference in capital costs decreases by 37%.

Furthermore, if costs for the six SEAS plants are computed from the data of model plants with wet air pollution control devices, the following costs are obtained:

	SEAS	NBER	% Difference
Capital, MM$	3.73(BPT+BAT)	3.73(BPT)	0
O&M, MM$	1.77(BPT+BAT)	0.52(BPT)	70.62

The differential in capital costs is eliminated entirely. However, it must be remembered that the SEAS estimate is for six plants, while NBER's is for five. This method of SEAS cost computation also slightly improves comparability with O&M cost estimates, but a 70.62% difference in costs still exists.

Since the total 1972 capacity for SEAS was only 9.9 MM tons, whereas NBER was 13.5 MM tons, yet SEAS computed higher O&M costs than NBER, it is assumed that the large difference in costs is accounted for by different methods of computation.

Blast Furnaces

Abatement costs for the subcategory are as follows:

	SEAS	NBER	% Difference
# Plants	68	68	
Capital MM$	203.00	140.57	30.75
O&M , MM$	243.15	8.13	96.66

Table 3 gives model plant data for the subcategory.

In comparing the SEAS 3109 ton per day capacity plant with the NBER model plant, capital costs are nearly equivalent.. The primary source of cost discrepancy appears to be in the different methods of model plant aggregation. If the entire 68 SEAS plants were modeled according to the 3109 tons per day plant, the following abatement costs would be obtained:

	SEAS	NBER	% Difference
Capital, MM$	140.35	140.57	0.002
O&M, MM$	127.36*	8.13	93.62

*In recomputing SEAS O&M costs, the 34 plants without wet air pollution control devices were modeled according to model plant #2, those with wet air pollution control devices were modeled according to #5. Since capital costs for the model plant is the same, no distinction is made.

The reaggregation of model plants reduces the difference in capital costs to less than 1% but O&M costs are affected only slightly. In 1972, SEAS capacity was nearly twice that of NBER (SEAS, -161.4 MM tons; NBER-82.1 MM tons), thereby, accounting for a large portion of the difference. Different O&M computational methods also are assumed to contribute to the error.

Hot Forming - Section

Abatement costs for the section hot forming subcategory are as follows:

	SEAS	NBER
# plants	85	80
Capital, MM$	46.94	172.9
O&M, MM$	8.92	12.46

Because of the differences in plant numbers, the abatement costs per ton of product are calculated to provide easier comparison:

	SEAS	NBER	% Difference
Capital, $/ton	2.04*	6.40	68.13%
O&M, $/ton	.53*	.46	13.21%

The reason for NBER and SEAS cost discrepancy is a combination of two factors:

*Average value

a) SEAS vs. NBER definition of BPT level treatment

b) Capital-in-place assumptions.

Table 4 gives model plant data for NBER and SEAS. In the table only NBER BPT costs are given, but SEAS BPT and BAT costs are given for existing KIP assumptions (BPT - 35% BAT-15%) and for K-I-P assumptions (both BPT and BAT) equal to zero. In the following table, NBER BPT abatement costs are compared with SEAS abatement costs for BPT, BPT + BAT with existing K-I-P, and BPT + BAT with zero, K-I-P. As the table shows, capital costs differences change from over 68% to less than 1%. O&M costs, on the other hand, are more comparable for BPT estimates by NBER and SEAS. The addition of SEAS BAT costs increases the difference in O&M costs from 13.21% to 36.11%. 1972 capacity figures for the sub-category are 27 MM tons for NBER and 23.0 MM tons for SEAS. Since O&M costs are higher for SEAS, whereas, the total capacity is lower, the difference in O&M costs is assumed to be due to the methods of computations.

	SEAS	NBER	% Difference
Capital, $/ton	2.04(BPT)	6.40 (BPT)	68.13
	4.86 BPT:KIP=.35 BAT:KIP=.15	6.40 (BPT)	24.06
	6.46 BPT:KIP=0 BAT:KIP=0	6.40 (BPT)	0.93
O&M, $/ton	.53 (BPT)	.46 (BPT)	13.21
	.72 (BPT+BAT)	.46 (BPT)	36.11

<u>Pipes and Tubes</u>

Abatement costs for the subcategory are as follows:

	SEAS	NBER	% Difference
# plants	75	50	----
Capital , MM$	1.74	26.04	93.32
O&M, MM$	0.14	2.66	94.74

Since the number of NBER and SEAS plants differ greatly, the abatement cost per ton of product is computed for easier comparison. These costs are given as follows:

	SEAS	NBER	% Difference
Capital, $/ton	.17*	4.90	96.53
O&M, $/ton	.01*	.43	97.67

*Average value

It was found that the principal reason for cost discrepancy occurs because of the level of technology that SEAS and NBER associate with BPT. As is true in previous comparison, NBER's BPT costs are more equivalent to SEAS BPT + BAT costs. Table 5 gives model plant data for NBER and SEAS (both BPT and BAT costs are given for SEAS, only BPT costs are given for NBER). The average SEAS capital cost increases from $.17/ ton to $4.86/ton when BAT costs are added to BPT costs. The NBER abatement cost is $4.90/ton, and the difference in costs is reduced to less than 1% by the inclusion of SEAS BAT costs. The change in abatement costs is shown in the following for both capital and O&M. Note that the difference in NBER and SEAS O&M costs is significantly reduced, however, it is still assumed that major reason for differences in O&M costs is due to computational methods.

	SEAS	NBER	% Difference
Capital, $/ton	.17 (BPT)	4.90 (BPT)	96.53
	4.86 (BPT+BAT)	4.90 (BPT)	0.82
O&M, $/ton	.01 (BPT)	.43 (BPT)	97.67
	.31 (BPT+BAT)	.43 (BPT)	27.91

Revised cost estimates for the subcategory (based on SEAS BPT + BAT costs) would give:

	SEAS	NBER
Capital , MM $	48.41	26.4
O&M, MM$	3.02	2.66

Hot Coatings

Abatement costs for the subcategory are as follows:

	SEAS	NBER	% Difference
# plants	30	30	-----
Capital , MM$	11.27	34.02	66.87
O&M, MM$	1.25	2.38	47.48

The discrepancy in cost estimates for hot coatings is due to the assumptions of BPT level treatment by NBER and SEAS. In Table 6, costs associated with BPT + BAT guidelines for the SEAS model plants are compared with BPT guideline costs for the NBER model plant. Revised estimates using BPT + BAT costs for SEAS give the following totals:

	SEAS	NBER	% Difference
Capital, MM$	31.46	34.02	7.52
O&M, MM$	2.82	2.38	15.60

Observe that the inclusion of SEAS BAT costs gives comparability of O&M costs as well as capital costs for this subcategory.

Cold Rolling

Abatement costs for the subcategory are as follows:

	SEAS	NBER	% Difference
# plants	45	45	--------
Capital, MM$	10.04	55.44	81.89
O&M , MM$	4.15	6.63	37.41

Table 7 gives model plant data for the subcategory. According to the data and EPA development documents, NBER defines two types of abatement technology, recirculation and recombination, whereas SEAS defines only one, recirculation, This difference in abatement technology gives rise to the difference in cost estimates. In order to equalize costs, the model plant data for NBER is redefined into one model plant utilizing recirculation technology. The model plant data for NBER would then become:

# plants	45
Capacity,	
t/day	4,500
t/yr	1,642,500
Investment	
Capital , MM$	0.375
O&M, MM$	0.0323

Based on this revision, industry abatement cost figures would become:

	SEAS	NBER	% Difference
Capital, MM$	10.04	16.86	40.45
O&M, MM$	4.15	1.46	64.82

The former discrepancy in capital cost figures is thus reduced by half. Simultaneously, the difference in O&M cost figures doubled. 1972 capacity figures for the cold rolling subcategory totals 54.9 mm tons for SEAS and only 26.8 MM tons for NBER, a figure of half of SEAS capacity. Therefore, the O&M figures are expected to be much higher for SEAS than for NBER. Methods in O&M computation are also assumed to increase the difference in O&M investment numbers.

IRON AND STEEL - New Production

The following total abatement cost estimates are given for the 14 industry subcategories common to both NBER and SEAS:

	SEAS	NBER	% Difference
Capital, MM$			
Existing Sources	643.64	886.13	27.37
New Production	329.17	107.70	67.28
TOTAL	972.81	993.83	2.12
O&M , MM$			
Existing Sources	426.35	107.89	
New Production	604.97	8.56	
TOTAL	1031.32	116.45	

SEAS predicts a cost of $329.17 MM for new production. This estimate includes $221.07 MM for expansion and $108.1 MM for new plants. NBER products a cost of $107.7 MM for added production (no distinction is made between expansion within existing facilities and new plants). These additional costs give total costs to the industry of $972.81 MM and $993.83 MM for SEAS and NBER. Notice that while a 27.37% difference in base level costs exists, a difference of only 2.12% occurs then total costs are considered. This discrepancy is apparently due to two factors:

1) The segment of the industry that is considered to be the base level differs for NBER and SEAS

2) New growth within SEAS is considered to be subject to guidelines other than BPT; NBER considers the new growth to be subject to BPT standards (the $108.1 MM SEAS investment for new plants is the cost due to NSPS guidelines).

IRON AND STEEL - OPE

The OPE document gives the following the abatement costs for the entire industry over the time period 1975-7977:

Capital $2310 MM - $1500 MM for existing sources, $810 MM for expansion

O&M $ - 840 MM-$680 MM for existing sources, $190 MM for expansion

In relation to NBER and SEAS, total costs are as follows:

	Costs in MM $		
Capital	OPE	NBER*	SEAS
Existing	1500	1100	643.64
New Production	810	107.7	329.17
Total	2310	1207.7	972.8
O&M	840	145.6	1031.3

OPE investment costs are much larger because it computes costs for a larger segment of the iron and steel industry. A more complete analysis will be prepared after examination of the primary source. Above totals were taken from secondary source.

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*NBER totals are for entire industry which includes 14 subcategories in common with SEAS .

TABLE 1 Subcategory	SEAS # Plants	 1972 Capacity MM Tons	 Capital MM$	 O&M MM$	NBER # Plants	 1972 Capacity MM Tons	 Capital MM$	 O&M MM$
Phase I								
Coke By-Product	66	87.4	6.79	31.17	66	64.2	15.57	10.74
Blast Furnace	68	161.4	203.00	243.16	68	82.1	140.58	8.13
Basic Oxygen Furnace	28	54.4	9.73	12.20	27	64.9	13.68	4.03
Electric Arc Furnace	8	3.3	0.58	1.35	8	5.3	2.49	0.20
Open Hearth Furnace	6	9.9	1.61	2.18	5	13.5	16.75	0.51
Phase II								
Cold Rolling	45	54.9	10.03	4.15	45	26.8	55.44	6.58
Hot Forming - Primary	65	100.0	36.53	10.35	65	80.0	51.52	5.18
Hot Forming - Section	85	23.0	46.95	8.92	80	27.0	172.90	12.46
Hot Forming - Flat	35	93.0	232.82	87.20	45	55.0	245.00	22.26
Pipes and Tubes	75	10.0	1.73	0.14	50	6.2	30.38	2.66
Hot Coatings - Galvanizing	30	7.5	11.26	1.25	30	5.5	34.02	2.38
Cold Coatings	45	13.5	47.37	5.60	25	7.5	34.86	5.74
Pickling - Batch Sulfuric	55	14.3	9.45	5.65	120	7.8	35.00	13.16
Pickling - Continuous Sulfuric	25	18.8	11.83	11.65	25	9.3	23.24	3.78
Pickling - Hydrochloric	16	2.0	13.95	1.38	12	12.5	14.70	10.08
TOTALS	652	653.4	643.63	426.35	671	467.6	886.13	107.89

TABLE 2

MODEL PLANT DATA - OPEN HEARTH FURNACES

SEAS - BPT + BAT
NBER - BPT Only

	SEAS						
	1	2	3	4	5	6	
# Plants	1	1	1	1	1	1	
	WOFSD			WFSD			
Capacity							
t/day	917	4,149	8,549	917	4,149	8,549	
t/yr	335,000	1,514,000	3,120,000	335,000	1,514,000	3,120,000	2,
Investment,							
Capital, MM$							
BPT	0.113	0.274	0.418	0.113	0.276	0.418	
BAT	0.287	0.688	1.023	0.159	0.363	0.540	
Total	0.400	0.951	1.441	0.272	0.637	0.958	
O&M, MM$							
BPT	0.0613	0.174	0.288	0.131	0.519	1.004	
BAT	0.0345	0.0805	0.121	0.0154	0.0399	0.0631	
Total	0.0958	0.255	0.409	0.146	0.559	1.067	

TABLE 3

MODEL PLANT DATA - BLAST FURNACES

SEAS - BPT
NBER - BPT

	SEAS						
	W/OFSD			WFSD			
	1	2	3	4	5	6	
# Plants	3	19	12	3	19	12	
Capacity							
t/day	875	3,109	13,293	875	3,109	13,293	
t/yr	319,000	1,135,000	4,852,000	319,000	1,135,000	4,852,000	1,2
Investment							
Capital, MM$	0.962	2.064	4.950	0.962	2.064	4.950	2
O&M, MM$	0.298	0.804	2.506	0.893	2.942	11.528	0

TABLE 4

MODEL PLANT DATA - SECTION HOT FORMING

SEAS - BPT + BAT
NBER - BPT Only

	SEAS 1	SEAS 2	SEAS 3	SEAS 4	SEAS 5	NBER
# Plants	7	14	23	24	17	80
Capacity						
t/day	719.4	765.2	739.7	721.5	757.8	925.0
t/yr	262,600	279,300	270,000	263,300	276,600	337,600
I. Investment						
Capital, MM$						
BPT*	0.539	0.568	0.552	0.537	0.563	2.160
BAT*	0.744	0.783	0.761	0.746	0.777	---
Total	1.283	1.351	1.313	1.283	1.340	2.160
O&M, MM$						
BPT	0.141	0.147	0.144	0.141	0.146	0.156
BAT	0.050	0.053	0.051	0.050	0.052	----
Total	0.191	0.200	0.195	0.191	0.198	0.156
Abatement Cost						
Capital, $/ton						
BPT*	2.06	2.03	2.04	2.04	2.03	6.40
BAT*	2.83	2.80	2.82	2.83	2.81	---
Total	4.89	4.83	4.86	4.87	4.84	6.40
O&M, $/ton						
BPT	.54	.53	.53	.53	.53	.46
BAT	.19	.19	.19	.20	.19	---
Total	.73	.72	.72	.73	.72	.46
II. Investment						
Capital, MM$						
BPT**	0.829	0.874	0.849	0.826	0.867	2.16
BAT**	0.876	0.921	0.896	0.878	8.914	---
Total	1.705	1.795	1.745	1.704	1.781	2.16
Abatement Cost						
Capital, $/ton						
BPT**	3.16	3.13	3.14	3.14	3.13	6.40
BAT**	3.34	3.30	3.32	3.33	3.30	---
Total	6.50	6.43	6.46	6.47	6.43	6.40

*SEAS Model: BPT - KIP = 35%;
BAT - KIP = 15%

**SEAS Model: BPT - KIP = 0
BAT - KIP = 0

SEAS - BPT + BAT
NBER - BPT Only

	SEAS					NBER
	1	2	3	4	5	
# Plants	3	7	19	26	20	50
Capacity						
t/day	365.3	352.3	360.4	368.8	369.9	340.0
t/yr	133,300	128,600	131,500	134,600	135,000	124,100
Investment						
Capital, MM$						
BPT	0.0231	0.0226	0.0229	0.0232	0.0232	0.608
BAT	0.622	0.611	0.618	0.625	0.626	---
Total	0.645	0.633	0.641	0.649	0.650	0.608
O&M, MM$						
BPT	0.00190	0.001883	0.001894	0.001907	0.001908	0.0545
BAT	0.0385	0.0380	0.0383	0.0382	0.0387	---
Total	0.0404	0.0399	0.0402	0.0401	0.0406	0.0545
Abatement Cost						
Capital, $/ton						
BPT	.17	.18	.17	.17	.17	4.90
BAT	4.67	4.75	4.70	4.65	4.65	---
Total	4.84	4.93	4.87	4.82	4.82	4.90
O&M, $/ton						
BPT	.01	.01	.01	.01	.01	.43
BAT	.30	.30	.30	.28	.28	---
Total	[illegible]	.31	.31	.29	.29	.43

TABLE 6
MODEL PLANT DATA - HOT COATINGS

SEAS - BPT + BAT
NBER - BPT Only

	SEAS					NBER
	1	2	3	4	5	
# Plants	1	3	3	6	17	30
Capacity						
t/day	821.9	616.4	753.5	719.2	664.8	503.0
t/yr	300,000	225,000	275,000	263,000	243,000	183,000
Investment						
Capital, MM$						
BPT	0.413	0.344	0.409	0.393	0.367	1.136
BAT	0.784	0.617	0.729	0.701	0.657	---
Total	1.193	0.960	1.138	1.094	1.024	1.136
O&M, MM$						
BPT	0.0477	0.0386	0.0447	0.0432	0.0408	0.0795
BAT	0.0596	0.0488	0.0561	0.0543	0.0514	---
Total	0.107	0.0874	0.101	0.0975	0.0922	0.0795

TABLE 7

MODEL PLANT DATA - COLD ROLLING

SEAS - BPT
NBER - BPT

	SEAS 1	SEAS 2	SEAS 3	SEAS 4	SEAS 5	NBER
# Plants	3	6	11	15	10	45
Capacity						
t/day	3,013.8	3,241.5	3,424.5	3,315.1	3,465.7	4,500
t/yr	1,100,000	1,183,000	1,250,000	1,210,000	1,265,000	1,643,000
Investment						
Capital, MM$	0.209	0.219	0.226	0.222	0.223	0.375
O&M, MM$	0.0887	0.0907	0.0934	0.0918	0.0939	0.0323

VI. ELECTRIC UTILITIES

Introduction:

The cost for the electric utilities industry to meet BPT guidelines in 1977 is projected by NBER and SEAS. In addition the "Economic and Financial Impacts of Federal Air and Water Pollution Controls on the Electric Utility Industry" prepared for the Office of Planning and Evaluation by Temple, Barker, and Sloane in May of 1976 is examined. This last document uses a data base of BPT cost projections to analyze economic and financial impacts. Their data base is largely taken from the EPA's "Economic Analysis of Effluent Guidelines, Steam Electric Powerplants" published in December of 1974. NBER and SEAS derive the bulk of their data from the "Development Document for Proposed Effluent Limitation Guidelines and New Source Performance Standards for the Steam Electric Power Generating" published in March of 1974.

The cost estimates for NBER, OPE, and SEAS are presented in Table VI-A. The NBER and SEAS estimates fit very closely while OPE presents the lowest estimates - but their estimate is for the years 1975-80 - but still varying by only 25% in investment cost and 50% in O&M. OEM cost derivations are not well documented. The development document acknowledges data on O&M costs is "sketchy." Because of the agreement between cost estimates the following discussion will confine itself to identifying differences between the studies without pinpointing specific cost consequences of these differences.

Categorization:

NBER and OPE consider only all steam electric powerplants, with NBER's estimates based on SIC 4911 (Electric Services) and 4931 (Electric and other Services Combined). SEAS, while also confining its data base to steam electric powerplants considers the same ones included in SICs 4911, 4931 as well as those in 4932 (Gas and other Services Combined). Category 4932 is defined as having the "major part though less than 95% of the establishments being exclusively gas operated. Therefore a small percentage of steam electric powerplants uncovered by NBER is included by SEAS.

Capacity:

Estimates for BPT investment costs are based on the number of generating facilities and the cost of installing pollution control technologies at those facilities. The comparison of numbers of plants and the total generating capacities from those plants that make up the data base for the different estimates provides an opportunity for seeing how the differences in estimates occurred. NBER counts 26 nuclear and 1011 fossil fuel plants in their data base, SEAS 1 nuclear and 1413 fossil fuel plants, while OPE does not document their number of plants counted. The three capacity figures (millions of KW) are for NBER: 355.1, OPE 476, and SEAS 507. The greater capacity figure for SEAS and their higher plant total is attributable in large part to SEAS's inclusion of gas associated plants from SIC 4932. NBER's higher number of nuclear plants partially accounts for their higher investment figure.

Equipment Costs:

Variations in equipment costs are noted by both the development document and the OPE report. Examination of one such estimate - the cost per KW for fossil fuel cooling towers - confirms these variations. The development document lists the cost as $8.6 while OPE lists $24.1, It should be noted that OPE specifies the type of cooling towers (mechanical) this cost is associated with while the development document does not.

Base Year:

The baseline year the different projections derive from is important. Radical plant changes were caused by the 1973-74 oil embargo. These changes are reflected by the OPE estimate published in 1976 but not by the development document (and consequently not by NBER and SEAS) which used data collected over the years 1966-69. Two major impacts of the oil embargo are: fuel prices have increased causing greater O&M costs, and planned expansions have been curtailed.

Fuel Mix:

The fuel mix projections influence the BPT cost estimates. For the 1974 baseline case SEAS and NBER estimate fossil fuels providing 76% of generating capacity while in the same year OPE estimates this to be 71.3%. A more detailed breakdown of fuel mixes appears in Table VI-B.

Model Plant Size:

NBER uses four model plant sizes; a 100 MW, 300 MW, and 600 MW size for fossil fueld units and a 1000 MW nuclear fueld unit, SEAS uses three ranges of models; less than 25 MW, 25-500 MW, and greater than 500 for fossil fueled units and a 773 MW size for nuclear fueld units. Costs per KW are lower for larger plants as economies of scale take place.

Additional Variables:

There are many other factors that influence investment costs. Major ones include land costs and age of the installed generating units. For example the development document estimates land costs ranging from $10,000 to $1,000,000 per acre depending on location. Age of installation of generating units is an important factor in determining costs also. Many facilities will have generating units dating from different years. This age of a unit in turn effects retrofit costs. Neither specific land cost inputs nor age data for generating units is obtainable from the documentation for the estimates at this time but both these variables will have some influence on cost estimates.

Summary:

- All cost estimates for NBER and SEAS are very close
- A number of variables account for these minor discrepencies, the most important of which are the number of nuclear plants in the baseline case and model plant size.
- OPE has lower estimates primarily due to a slightly later time frame and a more recent data base.

Table VI-A

BPT costs
(Millions of 1975 Dollars)

	NBER (1972-77)	OPE (1975-80)	SEAS (1974-77)
Investment	1222	900	1018.5
Expansion	1549	not available	1608.2
O & M	432	200	302.4

Table VI-B

Fuel Mix Comparison

	1970		1980		1990	
	NBER/ SES	OPE	NBER/ SES	OPE	NBER/ SES	OPE
Coal	54%	49%	41%	55%	30%	56%
gas	29%	18%	14%	19%	8%	11%
oil	15%	22%	14%	10%	9%	4%
nuclear	2%	10%	31%	16%	53%	28%